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THE USE OF OPERATIONAL AMPLIFIERS  
FOR PHASE TRUE DETECTION

By Roman Krawec

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NASA. Lewis Research Center,  
Cleveland, Ohio

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# THE USE OF OPERATIONAL AMPLIFIERS FOR PHASE TRUE DETECTION

By Roman Krawec

Lewis Research Center  
National Aeronautics and Space Administration  
Cleveland, Ohio

E-2443 A phase true detector for use in the audio range has been constructed using commercial plug in operational amplifiers. A diagram of the system is shown in figure 1.

Operation of the detector can be understood by referring to figure 2. The reference signal is amplified by a factor of ten and clipped to 24 volts peak to peak in the first amplifier. The clipping is performed by the two Zener diodes in the feedback loop. The reference signal is then fed into the summing amplifier in the form of a square wave. The summing amplifier has a gain of two for the reference signal and a gain of ten for the signal to be detected. With no signal present at the input, the summing amplifier output appears as shown in figure 2-a. The diode on the output of the summing amplifier clips the negative side of the square wave, leaving a train of positive pulses which the condenser C integrates to give a d.c. voltage.

If the signal to be detected is in phase with the reference signal, the output waveforms will be as shown in figure 2-b. It can be seen that the average d.c. level is raised by the input signal, the amount of increase depending on the amplitude of the input signal.

Similarly, if the input signal is 180 degrees out of phase with the reference, then it will subtract from the reference signal and lower the d.c. output

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as shown in figure 2-c. If the detected signal has some other phase relationship to the reference signal, then the output will fall between these extremes. If the signal is of a different frequency, then the net change will be zero when averaged over a sufficiently long period of time.

The unit was constructed using a Philbrick type K2-W and a type K2-XA operational amplifier. One of the biasing arrangements recommended by the manufacturer was used. The reference signal was 100 volts peak to peak. The detector was linear over a range of input signals from 0 to 2 volts RMS and gave a d.c. output ranging from 10.8 to 39.2 volts. The output with zero signal was adjusted to be 25 volts.

E-2443

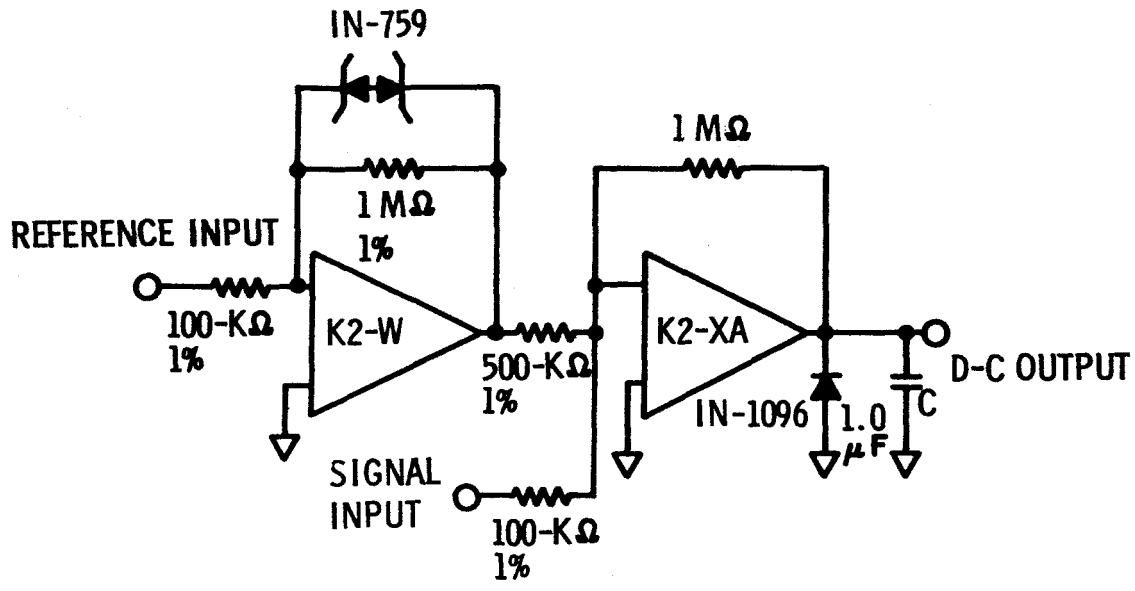


Figure 1. - Diagram of detector

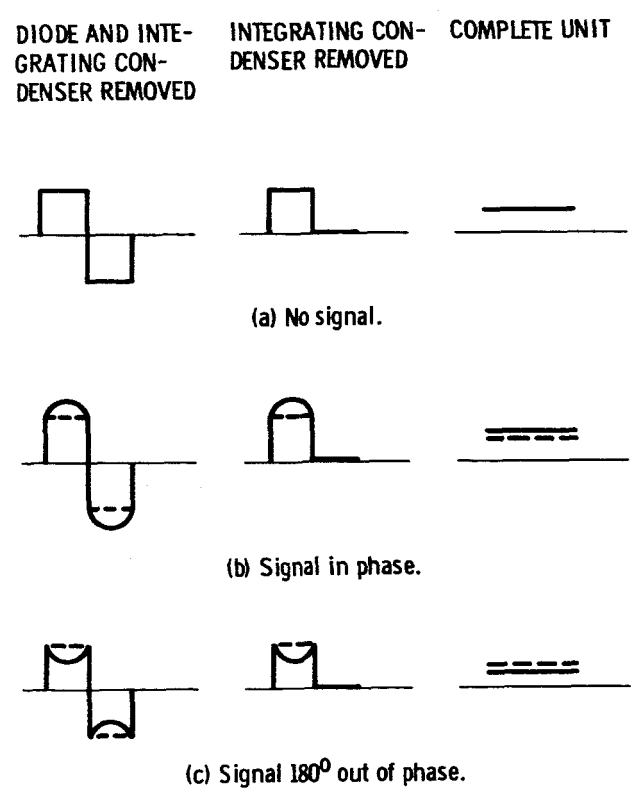


Figure 2. - Output of summing amplifier.